

# Comparing Media Types and Delivery Methods on Mobile Terminals

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**Abstract** -If a mobile phone user is given the choice of watching the latest TV news, listening to radio news, or reading text news on his mobile, which would he choose? In three study trials, mobile terminals were used in such a variety of situations that no single media type or delivery method was able to fulfill all needs. Unlike previous studies, the results indicate that mobile television does not receive low user commitment: users tended not to do anything else while watching. Furthermore, channel surfing or viewing an arbitrary flow of programs seems not to be enough. Although one of key motives of mobile television use is to kill time, people appear to want to kill time using the most appropriate media content and format for the moment. Entertainment in mobile broadcast content was found to be problematic because mobile viewing is typically short-term and fragmentary, meaning users often missed the beginnings of episodes.

**Keywords** -Mobile TV; Podcasting; DVB-H; 3G; smart phone; tablet computer; streaming video; media; usability

## I. INTRODUCTION

Watching television on a personal screen has been possible for decades, and portable televisions have been available to consumers since the 1960s. Until now, however, distribution technology and content and program schedules have been targeted at conventional television, not mobile use. Recent developments in smart phones with large touch screens, not to mention tablets, is paving the way for more personalized use of television – or, more generally, video – content. In addition to video, these personal mobile platforms are also capable of reproducing quality audio and larger screens are also making text more readable. This is generating competition between different media types: users can not only watch video, but also conveniently listen to audio and read text.

Two main approaches for delivering mobile TV exist: The first is through a broadcast network, in Europe most recently via DVB T2-Lite which allows simpler receiver implementations for very low capacity applications such as mobile broadcasting. T2-Lite signals can be multiplexed together with T2-base signals, carrying for instance HDTV services [2].

The second approach is to use unicast on-demand streaming over a mobile broadband network, such as 3G, 3.5G or LTE (Long Term Evolution). However, when the number of users increases, unicast streaming fails to scale up

as the network gets congested. Mobile broadband networks have been expected to get broadcast upgrades, such as MBMS (Mobile Broadcast for Multimedia Services) which is now taken into account as a main requirement in LTE standardization [6].

Generally speaking, broadcast is best suited to serving large audiences, since large-scale streaming of services can lead to network congestion. In addition to broadcast and streaming, there is also a third alternative for delivering mobile TV content to mobile terminals: downloading, or more accurately preloading, to the terminal memory prior to actual use. Preloading music to portable players has been a precursor for the preloading of mobile media in general: virtual radio stations, videos and user-generated content on the Internet can be preloaded to portable music players, such as the Apple iPod, hence the term ‘podcasting’, or to smart phones.

## II. PODRACING PROJECT AND THE FIELD TRIALS

VTT conducted the Podracing project between 2005 and 2007. The project posed the following primary question: If a mobile phone user were given the choice of watching the latest TV news, listening to radio news, or reading text news on their mobile, which would they choose? A secondary question was also presented: If content can be either preloaded to the mobile terminal automatically, received from a broadcast, or accessed from streaming services, which would the user prefer? The key aspects addressed were thus a) the media type, covering the alternatives ‘video’, ‘audio’ and ‘text’, and b) the delivery method, covering alternatives ‘podcast’, ‘broadcast’ and streaming (as ‘unicast’).

In order to compare podcasting as a mobile TV delivery method, we developed a mobile media prototype called Podracing. The project included three end-user trials, with the first and last trials based on the Podracing prototype.

The model of podcasting used in this project was a version of push technology, in the respect that the information provider chooses which files to offer in a feed, and the subscriber chooses from the available feeds. Preloaded to the mobile terminal, these contents were watchable even in the absence of a network connection.

At the time of the trials, mobile broadcasting had only limited coverage. Consequently, in the third trial we simulated broadcast by using scheduled content loops which the users

could join at any time, resembling tuning in to a broadcast channel on TV. The loops consisted of recent news or entertainment clips. For instance, one loop may have contained all the recent episodes of a TV series, while another loop the latest news editions. The loops were updated frequently as new content was published. Since this was a broadcast simulation, a second trial was conducted comparing usage of real DVB-H broadcasting and 3G unicasts.

The other motivation for the broadcast emulating loops was that the prime times for normal television are not optimized for mobile use, whereas with the loops the time of day was irrelevant.

In all trials, Symbian 3rd Edition Series 60 was used as the main terminal platform, supported by smart phones such as Nokia N70, N92, N93 and N95 [11]. The majority of users carried the trial phone as their primary mobile, using it for both professional and personal communication. A summary of the trials is presented in Table I below.

TABLE I SUMMARY OF THE TRIALS

Trial #	Trial Information				
	Topic	Begin	Duration	N	Age group
1	Media types	Mar 2006	1 Month	10 users	23Y to 56Y
2	DVB-H vs 3G	Oct 2006	1 Month	10 families	12Y to 56Y
3	MobileTV choices	May 2007	3 Months	10 users	24Y to 56Y

The users were interviewed and given information about the trial before the trial period. During the trial period, the users reported their user experiences in a test diary. After the trial, the users were asked to fill in a usability evaluation form and were interviewed again. The test group represented a wide range of user interests, with diversity of hobbies, lifestyles and media profiles.

#### A. The First Trial: Media Types for News Delivery

The first trial focused on different media types: video, audio and text. News content in these three media types was provided with equal importance through a unified user interface. All users in the trial were at least part-time employed and had used mobile services before.

Mobility and real-time were considered the most important characteristics in the first Podracing trial. In mobile news delivery, users appreciated both continuously updated information and media types that carry large amounts of information. These features, when integrated in a single service, challenge all services containing only one media type each. Having everything available in real time was considered important, and as a consequence only the latest news was in high demand. From the usability point of view, ease of use, quick launching and short response times were also appreciated.

Compared to earlier studies on mobile video content [13], some key changes have occurred in the technology platform. In particular, the use of earpieces with mobile phones has since become widespread due to the convenience of

consuming media content in privacy without disturbing others, for instance in public places.

When the users were able to receive news on their mobile phones through different media types, text was used most frequently (see Table II). Text news was typically considered the most universally useable format with respect to different contexts of use. Text was seen as especially convenient for quick 'on the go' news headline updates. Text-based news was also found to be less vulnerable to mobile network reception disturbance. However, in terms of total usage time, video news received the longest viewing sessions. Users watched video news less frequently than they read text news, but watched on-demand video news for longer, as opposed to glancing written news. In the interviews, users expressed the desire to receive individual video news clips as add-ons to specific text-based news items in preference to full news broadcasts which also contained items of less interest.

TABLE II USE OF DIFFERENT MEDIA TYPES

Media Type	Usage	
	Number of sessions	Total amount of time
Text	129	2h 40'
Audio	27	3h 42'
Video	80	10h 59'

Text was the most often used media type, but total usage time was longest for video.

Text was considered the most practical media type for news. On the other hand, when time was limited, video was considered a better source of concise information. When watching mobile video, the user's attention was focused on the mobile device: one or both hands were needed to hold the device, and users concentrated on watching the small screen and listening to the audio. Even in their home environment, users tended not to leave the mobile video on as 'background noise', even though sound levels were considered very good. Instead, the users continued to hold the phone in their hands and tended not to do anything else while watching. This finding was quite contrary to the low commitment expectation suggested by [8].

The number of audio news sessions was surprisingly low among the users, although the average duration of the sessions was equivalent to watching video. The reason for low use of audio news appears to be that the mobile phone model used (Nokia N70) had FM radio and users preferred listening to this in real time instead of selecting news items from the service. Use of the radio was taken into account in the interviews.

The test users considered the service most useful while they were on the move, as opposed to at home, or in situations where other media were available. However, they did use the service at home if they were not close to a TV set, mainly for quick checks and as a personal media device. The ability to select the most appropriate media format for the situation at hand was considered important. Audio was perceived to be especially suitable for situations where the user was moving, such as while walking, cycling or skating. When the user was

sitting or standing still, the media form of choice was more likely to be illustrated news, text or video.

### B. The Second Trial: DVB-H Versus 3G

The second trial compared mobile TV delivery methods: DVB-H broadcasting, 3G streaming and podcasting. Here again, the term 'podcast' refers to downloading content in advance.

The mobile TV services in the trial covered a wide range of content: from the main TV channels to sports news channels, fashion TV and user-generated content.

Poor reception quality was one of the key technical problems perceived by mobile TV users and was seen as a critical drawback.

Empirical research suggested that the users perceived a significant difference between the different delivery methods, i.e., mobile streaming, DVB-H and pre-downloading, and the difference was likely to affect the length of mobile TV viewing sessions. For instance, the mobile broadband network used during the test period presented a number of reliability and coverage problems. However, as the technology improves and gains more bandwidth and larger coverage areas, the mobile streaming experience is likely also to improve. Although podcasting to a mobile phone was a relatively new concept for the test users, they considered the delivery method to be useful, for instance, on long journeys and in places with no mobile network or DVB-H coverage. The clear advantage of podcasting is that the ability to watch podcasted content is not dependent on network connectivity and can thus be done anytime, anywhere.

The findings of the trial confirmed many previous studies concerning the use of mobile TV. Mobile television is most widely used outside the home [14], but it is also used within home contexts [1] – different content types are used in different locations [10]. The test users mainly chose contents and channel brands that were already familiar [3]. However, since the trial period was relatively short, we were not able to determine whether these behaviors would have changed over a longer period of time. Mobile TV alone resulted in a surprisingly high increase in media consumption. It would be interesting to determine whether there would be a corresponding decrease in time spent reading free newspapers, since some of the contexts in which these media are consumed, such as while commuting, are similar.

The study also indicated that the price of mobile TV services would be a significant factor for usage.

### C. The Third Trial: Mobile TV Choices

The purpose of the field study in the third trial was to explore users' mobile TV choices in different everyday situations. Qualitative and quantitative methods were combined to ensure adequate data was collected. Semi-structured interviews, questionnaires and media diaries helped to disclose users' media habits and how they present their expectations and preferences. We also asked the users to take photos with the camera phone of situations in which they might use the mobile TV service, as well as of other places or everyday things that are important to them. This helped us

gain an understanding about the role of media in their everyday life.

The trial period overlapped with the summer holiday for most of the test users. A typical summer holiday in Finland lasts four weeks and takes place in July.

Ten users were logged during the trial. Five of these had access to the service for around three months, two for approximately 2.5 months, one for about 2 months, one for 1 month, and one for 3 weeks. Additionally, one user took part in the interviews after briefly using the service.

On average, users accessed the Podracing service on 22 days of the trial period: in general the service was not used on a daily basis. Fig. 1 presents the usage over the entire test period. The first group of users received the service in mid May and the second group in June. No fixed end date was given for the trial, and the number of users decreased towards the end of the trial period. As the figure shows, the holiday period had no significant quantitative influence on usage.

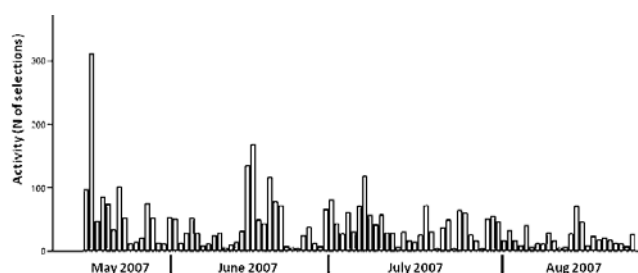


Fig. 1 Activity during the trial period

No everyday usage patterns emerged during the first week of the test period, as user behavior was erratic due to exploring different functions of the mobile phone and the Podracing service. After the first week, use of the service became more consistent. The first week is therefore excluded from the analysis, unless otherwise mentioned and discussed separately.

The users were able to navigate through the content by selecting the media brand first. They were familiar with each of the brands presented in the user interface and thus knew beforehand, what kind of contents to expect from them. Fig. 2 illustrates the user interface, which has media brands on the left column and the headings of individual contents on the right. A small icon indicates the media type of the content.



Fig. 2 An example of the user interface. Media brand was selected from the left column and the content from the right column.

Table III presents a comparison between text, on-demand streaming, downloaded podcast and broadcast emulating loops. The data for the first week, given in parentheses, may indicate the expectations and wishes of the users.

There were no significant changes in the proportions of each media type between the first week and the rest of the trial. Downloaded podcast episodes were viewed for a considerably longer time. The short duration of using streaming services and 'broadcast' loops during the first week can be explained by technical difficulties at the beginning of the trial. Text gained popularity after the first week when measured as percentage of consumed time.

TABLE III  
COMPARING MEDIA TYPES (1<sup>ST</sup> WEEK IN PARENTHESIS)

Delivery method	Usage data			
	Percentage of sessions	Average duration of a session	Percentage of time	Average total duration of consumed media
Text (on demand)	29% (24%)	2'02" (2'04")	10% (5%)	12'50" (3'19")
Streaming	21% (27%)	3'02" (3'37")	11% (9%)	14'10" (6'38")
Podcasting	7% (6%)	12'57" (30'37")	15% (16%)	19'25" (11'29")
"Broadcast"	35% (45%)	1'56" (2'19")	12% (10%)	14'57" (7'01")
Other	-	-	52% (60%)	1h 08' (44')

Most time was consumed in browsing Podracing service ("Other").

Fig. 3 illustrates the session durations when browsing text-based content. Although an average text article was fairly quick to read, taking on average 1 minute 18 seconds, several text articles were typically read in succession.

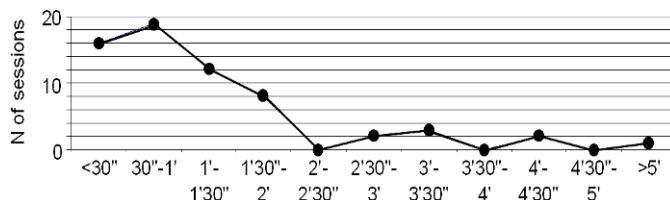


Fig. 3 Duration of text sessions

It is noteworthy that no streaming content was watched for more than 10 minutes solid. Streaming sessions were characteristically short, as illustrated in Fig. 4.

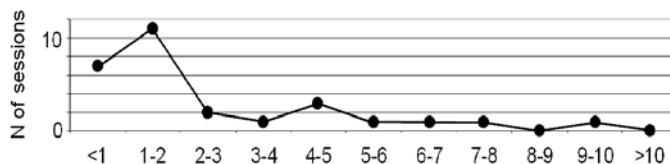


Fig. 4 Duration of streaming sessions (minutes)

Preloaded videos, on the other hand, were watched either as a quick preview or as an entire episode from the beginning to end, see Fig. 5.

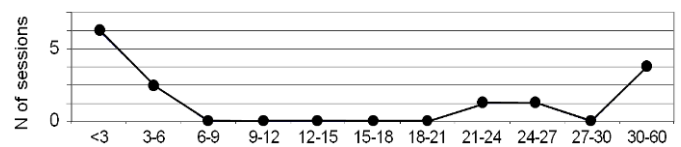


Fig. 5 Duration of preloaded content viewing (minutes)

In terms of prime time use, users accessed the service mainly in early morning and late night (Fig. 6), despite of the holiday season. Late night sessions were frequent, but short.

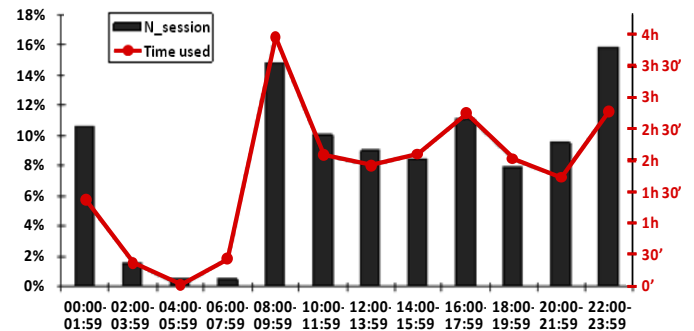


Fig. 6 Prime time: amount of sessions and consumed time

The first week use was relatively active, as seen in Fig. 7. The prime times during the first week were late afternoon and early evening, indicating that the try-out period was contrary to the rest of the trial also in this respect.

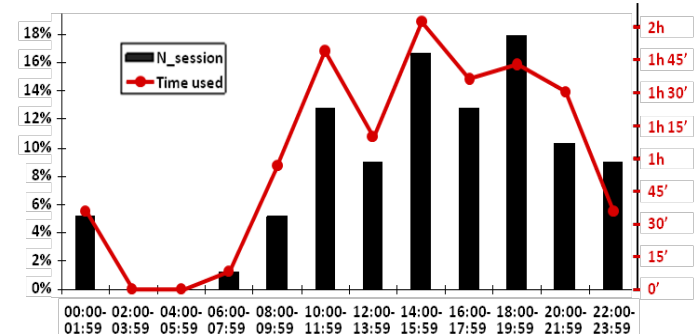


Fig. 7 Prime time: amount of sessions and consumed time during the first week of use.

#### D. Summary of Post-Trial Interviews

In the post-trial interviews, the test users expressed a desire to get a wide selection of mobile services to suit different use contexts, even though a use context might be just momentary. In addition, according to the interviews, appropriate content should be found within 30 seconds from launching the service.

Whilst the use of mobile television is usually spontaneous, a proportion of users seem to want access to niche content even for these brief moments of viewing.

Previous studies have suggested that mobile television receives low user commitment [8] [10] [14]. This is contrary to the findings of Podracing: as reported in the interviews, users tended not to do anything else while watching. Furthermore, viewing an arbitrary flow of content seems not be enough. Although one of key motives of mobile television use is to kill time, people appear to want to kill time by using

the most appropriate media content and format for the moment.

Just as mobile television, the Podracing service was not a solely public place medium, since it was used in several home contexts in addition to work context and public areas.

When asked more closely which content types they preferred in different contexts and use situations, test users said that the use of the service was more versatile at home, than it was for example while commuting or travelling. Different media types were accessed most often at home.

Mobile users do not choose a time when to watch television. In Podracing, broadcast was emulated using program loops. In general, the users disliked loops with entertainment content, saying that they want to see the series from the beginning, even though mobile viewing is often short-term and sporadic. Consequently, as far as broadcast entertainment was concerned, there was some irritation caused by missing the beginnings of episodes: some users also stated that 'trash' entertainment might work better, as there is no need to see the complete episode.

### III. DISCUSSION

Use contexts, mobile news prime time, preferred mobile TV contents, quality issues and interactive services studied in the project have been reported by the authors in 2008 [12]. The analysis of log data introduced in this paper complements these results.

After years of rapid technology development, how do these results apply to the status quo?

Since the trials were conducted, smart phones with large displays and higher resolutions have become commonplace, while mobile networks have gained more bandwidth. In this respect, it should be taken into account that television sets have evolved to high definition and also grown in size and resolution. Thus, the quality difference between a living room television and a mobile terminal still remains. However, a new intermediate level, i.e. tablets, has emerged:

Several recent studies, such as Tablet Survey [4] and UK iPad usage survey [7], indicate that reading the news is popular on the tablet platform, and so is Internet browsing. However popularity of entertainment is interestingly less clear, since the Tablet Survey classifies "consuming entertainment" to the category of "least popular", while UK iPad usage survey reports a vast majority of UK iPad users watching either YouTube or catch-up TV.

From the days of the trials, we do expect no change in the motivation for reading text news, although reading the news may nowadays be an integral part of Internet browsing. Streaming services have evolved since, screens are larger, and broadband Internet has nowadays better access. Thus, if the trials would have been conducted today, we would have expected resembling shapes in the graphs of this paper, excluding the results for streaming sessions.

However, since tablets have been reported to be primarily used in the home context, they can not be just seen as an evolution of smart phones which are mobile by nature.

Both mobile phones and tablets are increasingly becoming an instantaneous channel for news dissemination and discussion via social media. Especially among young people, Facebook has become the main source of news, instead of accessing news directly from online mainstream media portals [5]. The importance of social media in mobile platforms is evident [4] [5] [7] [9] and it has also changed Internet usage in general.

Thus, comparing tablets with smart phones, and adding social media and Internet browsing to the presented concept, is worth a further study.

### IV. CONCLUSIONS

Based on log data and interviews, the authors have presented how different media types, video, audio or text, as well as different delivery methods, 'podcast', 'broadcast' and streaming were used on mobile terminals.

Although the number of participants in the trials was limited, the results of the project indicate that mobile terminals were used in such a variety of situations that no single media type or delivery method was able to fulfil all needs. Today, with social media emerging on mobiles, needs are even more versatile.

For news, text was considered the most practical media type, especially convenient for quick 'on the go' news headline updates. On the other hand, video was considered a better source of concise information.

Different media types were accessed mostly at home, while at work or in public areas the users had a tendency to select a specific media type.

No everyday usage patterns emerged during the first week of the test period, as user behaviour was erratic due to exploring different functions of the mobile phone and the Podracing service. A period considerably longer than one week would be necessary for any subsequent study.

Contrary to previous studies [8] [10] [14], the post-trial interviews did not suggest low user commitment for mobile video. Users tended not to do anything else while watching.

In the post-trial interviews the users presented a specific wish for quick navigation, which is beneficial when designing new services. As an example of one alternative, Podracing provided fairly quick access to content by enabling users to navigate through media brands already familiar to them.

Whilst the use of mobile television is usually spontaneous, certain users demand niche content even for short moments of viewing. The irritation of not seeing the beginning of the show can be expected to apply also to broadcast entertainment in mobile television in general.

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